Claims:

1. Torque sensor having a sensor element, wherein the sensor element is manufactured in accordance with the following manufacturing steps:

applying a first current pulse to the sensor element;

wherein the first current pulse is applied such that there is a first current flow in a first direction along a longitudinal axis of the sensor element;

wherein the first current pulse is such that the application of the current pulse generates a magnetically encoded region in the sensor element.

2. The torque sensor of claim 1,

wherein a second current pulse is applied to the sensor element;

wherein the second current pulse is applied such that there is a second current flow in a second direction along the longitudinal axis of the sensor element.

3. The torque sensor of one of claims 1 or 2,

wherein each of the first and second current pulses has a raising edge and a falling edge;

wherein the raising edge is steeper than the falling edge.

4. The torque sensor of one of claims 2 or 3,

wherein the first direction is opposite to the second direction.

5. The torque sensor of one of claims 1 to 4,

wherein the sensor element has a circumferential surface surrounding a core region of the sensor element;

wherein the first current pulse is introduced into the sensor element at a first location at the circumferential surface such that there is the first current flow in the first direction in the core region of the sensor element; and

wherein the first current pulse is discharged from the sensor element at a second location at the circumferential surface;

wherein the second location is at a distance in the first direction from the first location.

6. The torque sensor of one of claims 2 to 5,

wherein the second current pulse is introduced into the sensor element at the second location at the circumferential surface such that there is the second current flow in the second direction in the core region of the sensor element; and

wherein the second current pulse is discharged from the sensor element at the first location at the circumferential surface.

7. The torque sensor of one of claims 5 or 6,

wherein the sensor element is a shaft;

wherein the core region extends inside the shaft along its longitudinal extension such that the core region surrounds a center of the shaft;

wherein the circumferential surface is the outside surface of the shaft;

wherein the first and second locations are respective circumferential regions at the outside of the shaft.

8. The torque sensor of one of claims 1 to 7,

wherein the first current pulse is not applied to the sensor element at an end face of the sensor element.

9. The torque sensor of one of claims 1 to 8,

wherein the first current pulse has a first maximum between 40 and 1400 Ampere.

10. The torque sensor of one of claims 1 to 9,

wherein the first current pulse has a first maximum between 60 and 800 Ampere.

11. The torque sensor of one of claims 1 to 10,

wherein the first current pulse has a first maximum between 75 and 600 Ampere.

12. The torque sensor of one of claims 1 to 11,

wherein the first current pulse has a first maximum between 80 and 500 Ampere.

13. The torque sensor according to one of claims 9 to 12,

wherein a second maximum of the second pulse essentially corresponds to the first maximum.

14. The torque sensor of claim 3,

wherein a first duration of the first current pulse is significant longer than a second duration of the second current pulse.

15. The torque sensor of claim 14,

wherein the first duration is smaller than 300 ms;

wherein the second duration is larger than 300 ms.

16. The torque sensor according to one of claims 14 to 15,

wherein the first duration is smaller than 200 ms;

wherein the second duration is larger than 400 ms.

17. The torque sensor according to one of claims 14 to 16,

wherein the first duration is between 20 ms to 150 ms;

wherein the second duration is between 180 ms to 700 ms.

18. The torque sensor of one of claims 1 to 17,

wherein a plurality of first current pulses are applied.

19. The torque sensor of one of claims 1 to 18,

wherein a plurality of second current pulses are applied.

20. The torque sensor of one of claims 1 to 19,

wherein the sensor element is made of steel.

21. The torque sensor of one of claims 1 to 20,

wherein the steel includes nickel.

22. The torque sensor of one of claims 1 to 21,

wherein the first current pulse is applied by means of an electrode system having at least a first electrode and a second electrode;

wherein the first electrode is located at the first location and the second electrode is located at the second location.

23. The torque sensor of claim 22,

wherein each of the first and second electrodes has a plurality of electrode pins;

wherein the plurality of electrode pins of each of the first and second electrodes are arranged circumferentially around the sensor element such that the sensor element is contacted by the electrode pins of the first and second electrodes at a plurality of contact points at an outer circumferential surface of the shaft at the first and second locations.

24. The torque sensor of one of claims 1 to 23,

wherein at least one of the first current pulse and at least one of the second current pulse are applied to the sensor element such that the sensor element has a magnetically encoded region;

wherein, in a direction essentially perpendicular to a surface of the sensor element, the magnetically encoded region of the sensor element has a magnetic field structure such that there is a first magnetic flow in a first direction and a second magnetic flow in a second direction; and

wherein the first direction is opposite to the second direction.

25. The torque sensor of one of claims 1 to 24,

wherein in a cross-sectional view of the sensor element, there is a first circular magnetic flow having the first direction and a first radius and a second circular magnetic flow having the second direction and a second radius;

wherein the first radius is larger than the second radius.

26. The torque sensor of one of claims 1 to 25,

wherein the sensor element has a first pinning zone adjacent to the first location and a second pinning zone adjacent to the second location.

27. The torque sensor of claim 26,

wherein, for forming the first pinning zone, at the first location or adjacent to the first location, a third current pulse is applied on the circumferential surface to the sensor element such that there is a third current flow in the second direction;

wherein the third current flow is discharged at a third location which is displaced from the first location in the second direction.

28. The torque sensor of one of claims 26 or 27,

wherein, for forming the second pinning zone, at the second location or adjacent to the second location, a fourth current pulse is applied on the circumferential surface to the sensor element such that there is a fourth current flow in the first direction;

wherein the fourth current flow is discharged at a forth location which is displaced from the second location in the first direction.

29. Torque sensor, comprising:

a first sensor element with a magnetically encoded region; and

wherein the first sensor element has a surface;

wherein, in a direction essentially perpendicular to the surface of the first sensor element, the magnetically encoded region of the first sensor element has a magnetic field structure such that there is a first magnetic flow in a first direction and a second magnetic flow in a second direction; and

wherein the first direction is opposite to the second direction.

30. The torque sensor of claim 29, further comprising:

a second sensor element with at least one magnetic field detector;

wherein the second sensor element is adapted for detecting variations in the magnetically encoded region.

31. The torque sensor of one of claims 29 to 30,

wherein the magnetically encoded region extend longitudinally along a section of the first sensor element, but does not extend from one end face of the first sensor element to the other end face of the first sensor element.

32. The torque sensor of one of claims 29 to 31,

wherein the first sensor element has variations in the material of the first sensor element caused by at least one current pulse or surge applied to the first sensor element for altering the magnetically encoded region.

33. The torque sensor of claim 32,

wherein the variations are at an outer surface of the sensor element and not at the end faces of the first sensor element.

34. The torque sensor of one of claims 29 to 33,

wherein the first sensor element is made of steel.

35. The torque sensor of claim 34,

wherein the steel includes nickel.

36. The torque sensor of one of claims 29 to 35,

wherein in a cross-sectional view of the first sensor element, there is a first circular magnetic flow having the first direction and a first radius and a second circular magnetic flow having the second direction and a second radius;

wherein the first radius is larger than the second radius.

37. The torque sensor of one of claims 29 to 36,

wherein the magnetically encoded region of the first sensor element has first pinning regions adjacent to end regions of the magnetically encoded region.

38. Torque sensor of one of claims 29 to 37,

wherein the first sensor element is a shaft.

39. Method of magnetically encoding a sensor element for a torque sensor, the method comprising the steps of:

applying a first current pulse to sensor element;

wherein the first current pulse is applied such that there is a first current flow in a first direction along a longitudinal axis of the sensor element;

wherein the first current pulse is such that the application of the current pulse generates a magnetically encoded region in the sensor element.

40. The method of claim 39,

wherein a second current pulse is applied to the sensor element;

wherein the second current pulse is applied such that there is a second current flow in a second direction along the longitudinal axis of the sensor element.

41. The method of one of claims 39 to 40,

wherein each of the first and second current pulses has a raising edge and a falling edge;

wherein the raising edge is steeper than the falling edge.

42. The method of one of claims 39 to 41,

wherein the first direction is opposite to the second direction.

43. The method of one of claims 39 to 42,

wherein the sensor element has a circumferential surface surrounding a core region of the sensor element;

wherein the first current pulse is introduced into the sensor element at a first location at the circumferential surface such that there is the first current flow in the first direction in the core region of the sensor element; and

wherein the first current pulse is discharged from the sensor element at a second location at the circumferential surface;

wherein the second location is at a distance in the first direction from the first location.

44. The method of one of claims 40 to 43,

wherein the second current pulse is introduced into the sensor element at the second location at the circumferential surface such that there is the second current flow in the second direction in the core region of the sensor element; and

wherein the second current pulse is discharged from the sensor element at the first location at the circumferential surface.

45. The method of one of claims 43 to 44,

wherein the sensor element is a shaft;

wherein the core region extends inside the shaft along its longitudinal extension such that the core region surrounds a center of the shaft;

wherein the circumferential surface is the outside surface of the shaft;

wherein the first and second locations are respective circumferential regions at the outside of the shaft.

46. The method of one of claims 39 to 45,

wherein the first current pulse is not applied to the sensor element at an end face of the sensor element.

47. The method of one of claims 39 to 46,

wherein the first current pulse has a first maximum between 40 and 1400 Ampere or wherein the first current pulse has a first maximum between 60 and 800 Ampere or wherein the first current pulse has a first maximum between 75 and 600 Ampere or wherein the first current pulse has a first maximum between 80 and 500 Ampere.

48. The method of claim 47,

wherein a second maximum of the second pulse essentially corresponds to the first maximum.

49. The method of claim 41,

wherein a first duration of the first current pulse is significant longer than a second duration of the second current pulse.

50. The method of claim 49,

wherein the first duration is smaller than 300 ms and the second duration is larger than 300 ms or wherein the first duration is smaller than 200 ms and the second duration is larger than 400 ms or wherein the first duration is between 20 to 150 ms and the second duration is between 180 to 700ms.

51. The method of one of claims 39 to 50,

wherein a plurality of first current pulses are applied.

52. The method of one of claims 39 to 51,

wherein the first current pulse is applied by means of an electrode system having at least a first electrode and a second electrode;

wherein the first electrode is located at the first location and the second electrode is located at the second location.

53. The torque sensor of claim 52,

wherein each of the first electrodes has a plurality of electrode pins;

wherein the plurality of electrode pins of each of the first and second electrodes are arranged in circumferentially around the sensor element such that the sensor element is contacted by the electrode pins of the first and second electrodes at a plurality of contact points at an outer circumferential surface of the shaft at the first and second locations.

54. The method of one of claims 39 to 53,

wherein at least one of the first current pulse and at least one of the second current pulse are applied to the sensor element such that the sensor element has a magnetically encoded region;

wherein, in a direction essentially perpendicular to a surface of the sensor element, the magnetically encoded region of the sensor element has a magnetic field structure such that there is a first magnetic flow in a first direction and a second magnetic flow in a second direction; and

wherein the first direction is opposite to the second direction.

55. The method of one of claims 39 to 54, further comprising the step of:

providing a first pinning zone adjacent to the first location and a second pinning zone adjacent to the second location.

56. The method of claim 55, further comprising the step of:

forming the first pinning zone by applying a third current pulse to the circumferential surface of the sensor element at the first location or adjacent to the first location, such that there is a third current flow in the second direction;

wherein the third current flow is discharged at a third location which is displaced from the first location in the second direction.

57. The method of one of claims 55 to 56, further comprising the step of:

forming the second pinning zone, at the second location or adjacent to the second location, by applying a forth current pulse on the circumferential surface to the sensor element such that there is a forth current flow in the first direction;

wherein the forth current flow is discharged at a forth location which is displaced from the second location in the first direction.

58. Method of magnetizing a metallic body element, the method comprising:

applying at least two current pulses to the metallic body element such that in a direction essentially perpendicular to a surface of the metallic body element, a magnetic field structure is generated such that there is a first magnetic flow layer in a first direction and a second magnetic flow layer in a second direction;

wherein the first direction is opposite to the second direction.

59. The method according to claim 58,

wherein, in a time versus current diagram, each of the at least two current pulses has a fast raising edge which is essentially vertical and has a slow falling edge.

60. Shaft for a magnetic sensor having, in a cross section thereof, at least two circular magnetic loops running in opposite directions.

61. Shaft according to claim 60, wherein the at least two circular magnetic loops are arranged concentrically.

62. Shaft for a torque sensor, wherein the shaft is manufactured in accordance with the following manufacturing steps:

applying a first current pulse to the shaft;

wherein the first current pulse is applied such that there is a first current flow in a first direction along a longitudinal axis of the shaft;

wherein the first current pulse is such that the application of the current pulse generates a magnetically encoded region in the shaft.

63. The shaft of claim 62,

wherein a second current pulse is applied to the shaft;

wherein the second current pulse is applied such that there is a second current flow in a second direction along the longitudinal axis of the shaft.

64. Electrode system for applying current surges to a sensor element for a torque sensor, the electrode system comprising:

at least a first electrode and a second electrode;

wherein the first electrode is adapted for location at a first location on an outer surface of the sensor element;

wherein the second electrode is adapted for location at a second location on the outer surface of the sensor element;

wherein the first and second electrodes are adapted for applying and discharging at least one current pulse at the first and second locations such that current flows within a core region of the sensor element are caused;

wherein the at least one current pulse is such that a magnetically encoded region can generated at a section of the sensor element.

65. The electrode system of claim 64,

wherein the electrode system comprises at least two groups of electrodes, each comprising a plurality of electrode pins;

wherein the electrode pins of each electrode are arranged in a circle such that the sensor element is contacted by the electrode pins of the electrode at a plurality of contact points at an outer surface of the sensor element.

66. The electrode system of claims 64 or 65,

wherein the outer surface includes not the end faces of the sensor element.

67. The electrode system of one of claims 64 to 66,

wherein the at least one current pulse has a maximum between 40 and 1400 Ampere or wherein the at least one current pulse has a maximum between 60 and 800 Ampere or wherein the at least one current pulse has a maximum between 75 and 600 Ampere or wherein at least one current pulse has a maximum between 80 and 500 Ampere.